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특허청
의견제출통지서

李東烈合同特許法律事務所 接 2004. 8. 09 受 1114

출원인	명칭	가부시키가이샤 무라타 세이사쿠쇼 (출원인코드: 519980960646)
	주소	일본국 교토후 나가오카쿄시 덴진 2초메 26방 10고
대리인	성명	박종한 외 2 명
	주소	서울특별시 강남구 역삼동 648-23 려삼빌딩 901호 윤동열합동특허법율사무소
출원번호		10-2001-0054418
발명의 명칭		단면반사형 표면파 장치의 주파수 특성의 조절방법 및단면반사형 표면파 장치의 제조방법

이 출원에 대한 심사결과 아래와 같은 거절이유가 있어 특허법 제63조의 규정에 의하여 이를 통지하오니 의견이 있거나 보정이 필요할 경우에는 상기 제출기일까지 의견서[특허법시행규칙 별지 제25호의2서식] 또는/및 보정서[특허법시행규칙 별지 제5호서식]를 제출하여 주시기 바랍니다.(상기 제출기일에 대하여 매회 1월 단위로 연장을 신청할 수 있으며, 이 신청에 대하여 별도의 기간연장승인통지는 하지 않습니다.)

[이 유]

이 출원의 특허청구범위 전항에 기재된 발명은 그 출원전에 이 발명이 속하는 기술분야에서 통상의 지식을 가진 자가 아래에 지적한 것에 의하여 용이하게 발명할 수 있는 것이므로 특허법 제29조제2항의 규정에 의하여 특허를 받을 수 없습니다.

-아 래-

1. 본원 발명의 청구범위 전항은 표면파장치의 주파수 특성의 조절방법 및 표면파장치의 제조방법에 관한 것입니다. 먼저 청구범위 제 1항 - 7항은 압전기판, IDT를 포함하는 표면파 장치의 주파수 특성의 조절방법으로서 주파수특성을 측정하는 단계, 주파수특성에 의하여 압전기판이 절삭되는 단계등을 특징으로 하는데, 이는 탄성표면파필터의 주파수조정방법에 관한 것으로서 압전기판, IDT등으로 구성되며 주파수를 측정하여 그 결과에 의하여 식각처리하는 것등을 특징으로 하는 인용발명 1(일본국 특개평 8-48467호)과 탄성표면파디바이스의 중심주파수조정방법 및 탄성표면파디바이스의 제조방법에 관한 것으로서 압전기판에 탄성표면파디바이스를 제조하고 주파수특성을 측정하여 식각하는 것등을 특징으로 하는 인용발명 2(일본국 특개평 12-156620호)의 결합으로부터 이 기술분야에서 통상의 지식을 가진 자라면 본원을 용이하게 발명할 수 있는 것이며, 청구항 8항 - 15항은 표면파장치의 제조방법에 관한 것으로서 IDT를 형성하는 단계, 기판을 절삭하는 단계, 표면파장치를 제조하는 단계, 주파수특성을 측정하는 단계, 측정된 주파수특성에 기초하여 단면의 위치를 결정하는 것등을 특징으로 하는데, 이는 이와 유사한 목적과 방법(구성)을 특징으로 하는 인용발명2와 탄성표면파장치 및 제조방법에 관한 것으로서 압전기판, IDT등으로 구성되며 주파수특성에 의하여 구성관계가 이루어지는 것등을 특징으로 하는 인용발명 3(일본국 특개평9-186553호)의 결합으로부터 이 기술분야에서 통상의 지식을 가진자라면 본원을 용이하게 발명할 수 있는 것으로 판단됩니다.

[첨 부]

첨부 1 인용발명 1: 일본공개특허공보 평08-046467호(1996.02.16) 1부.
첨부2 인용발명 2: 일본공개특허공보 평12-156620호(2000.06.06) 1부.
첨부3 인용발명 3: 일본공개특허공보 평09-186553호(1997.07.15) 1부. 끝.

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2004.08.06

특허청 전기전자심사국

전자심사담당관실 심사관 김재문

<<안내>>

문의사항이 있으시면 ☎ 042-481-5673 로 문의하시기 바랍니다.
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PATENT ABSTRACTS OF JAPAN

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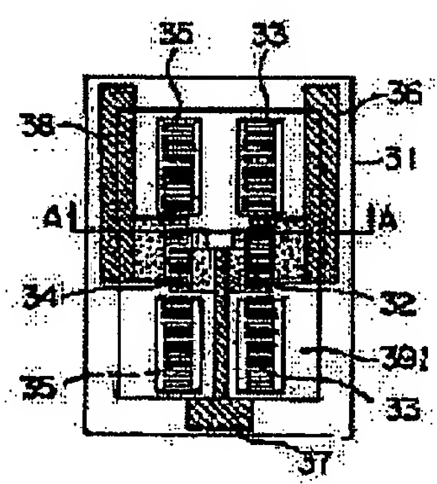
SAKAMOTO NOBUYOSHI

(54) ADJUSTING METHOD FOR FREQUENCY OF RESONATOR SURFACE ACOUSTIC WAVE FILTER

(57)Abstract:
PURPOSE: To adjust the frequency characteristic of a resonator surface acoustic wave filter.
CONSTITUTION: An insulating film 39A is adhered to cover the whole of an IDT 32, a grating reflector 33, an IDT 34 and a grating reflector 35, the both propagation speed of an SAW generated in a serial arm SAW resonator and a parallel arm SAW resonator lower by the same speed, and the both reactance characteristics of the serial arm SAW resonator and the parallel arm SAW resonator are moved to a low frequency side. Because this moving amount can be adjusted by the film thickness of the insulating film 39A, the insulating film 39A is adhered till a frequency characteristic becomes a desired one. By this procedure, the frequency adjustment of a resonator surface acoustic wave filter can be performed.



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【인용발명 1: 일본공개특허공보 평08-046467호(1996.02.16) 1부.】

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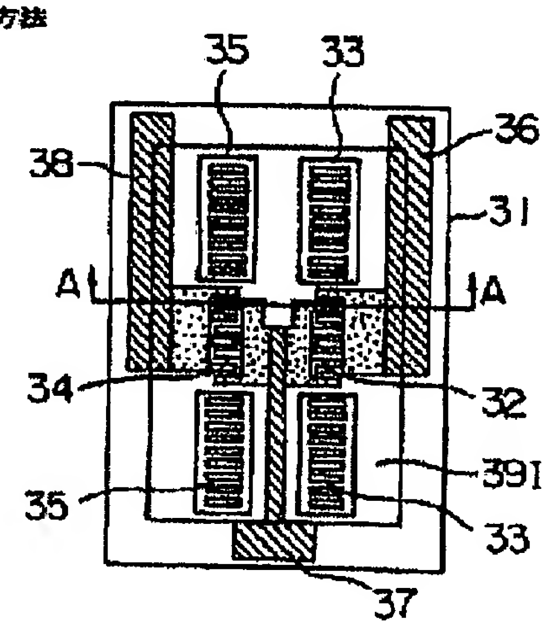
最終頁に続く

(54)【発明の名称】　共振器型弾性表面波フィルタの周波数調整方法

(57)【要約】
【目的】　共振器型弾性表面波フィルタの周波数特性を調整する。
【構成】　IDT32、グレーティング反射器33、IDT34、及びグレーティング反射器35全体を覆うように絶縁膜39Aを被着すると、直列腕SAW共振子及び並列腕SAW共振子で発生したSAWの伝搬速度は共に同じ速度だけ低下し、直列腕SAW共振子及び並列腕SAW共振子のリアクタンス特性は共に低周波側へ移動する。この移動量は絶縁膜39Aの膜厚により調整できるので、所望の周波数特性になるまで絶縁膜39Aを被着させる。以上の手順で共振器型弾性表面波フィルタの周波数調整を行うことができる。



本発明の第1の実施例の周波数調整方法1

【特許請求の範囲】

【請求項１】 圧電基板上に設けられ、電気信号を弾性表面波に変換した後にその弾性表面波を電気信号に変換する弾性表面波共振子を複数個用いた直列腕弾性表面波共振子及び並列腕弾性表面波共振子からなる梯子型回路に構成された共振器型弾性表面波フィルタにおいて、
前記直列腕弾性表面波共振子の共振周波数又は反共振周波数を測定し、
その測定結果と前記共振器型弾性表面波フィルタの中心周波数との比較により該直列腕弾性表面波共振子上に絶縁膜を被着するか又はエッチング処理を施して該直列腕弾性表面波共振子の共振周波数又は反共振周波数を調整し、
前記並列腕弾性表面波共振子の反共振周波数又は共振周波数を測定し、
その測定結果と前記共振器型弾性表面波フィルタの中心周波数との比較により該並列腕弾性表面波共振子上に絶縁膜を被着するか又はエッチング処理を施して該並列腕弾性表面波共振子の反共振周波数又は共振周波数を調整することを、
特徴とする共振器型弾性表面波フィルタの周波数調整方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、携帯電話装置等の高周波信号処理部等に用いられる共振器型弾性表面波（Surface Acoustic Wave、以下、ＳＡＷという）フィルタにおける周波数調整方法に関するものである。

【０００２】

【従来の技術】弾性表面波装置は、圧電基板上に配置されたすだれ状電極或いは変換器（Interdigital Transducer、以下、ＩＤＴという）により、電気信号を弾性表面波に変換する装置である。なかでも弾性表面波フィルタは小型、軽量、無調整という特長をもち、その製造プロセスには半導体デバイスの製造に用いられるフォトリソグラフィ技術を利用できるため量産性にも優れている。一般にＳＡＷフィルタはトランスバーサル型と共振器型とに分類される。図２は、従来の一般的なトランスバーサル型ＳＡＷフィルタの構成を示す構造図である。このトランスバーサル型ＳＡＷフィルタには、圧電基板１上に入力端子２に接続された複数個の入力用ＩＤＴ３と、出力端子５に接続された複数個の出力用ＩＤＴ４が設けられている。トランスバーサル型ＳＡＷフィルタは、入力用ＩＤＴ３と出力用ＩＤＴ４とを交互に多数配置した構造になっている。図３は、ＳＡＷ共振子の概念図である。このＳＡＷ共振子は、ＩＤＴ６及びグレーティング反射器７を備えている。共振器型ＳＡＷフィルタは、ＩＤＴとグレーティング反射器とで構成されたＳＡＷ共振子を用いて構成されたものである。共振器型ＳＡＷフィルタは、梯子型と２重モード型とに分類される。図４は、図３に示すＳＡＷ共振子を２個用いた梯子型回路の構成図であり、図５は、２重モード型ＳＡＷ共振子の構成図である。一般に、共振器型ＳＡＷフィルタは、トランスバーサル型ＳＡＷフィルタに比べて低損失、高減衰量、狭帯域、及び整合回路不要という特徴がある。

【０００３】図６は、反射器型ＳＡＷ共振子の平面図である。このＳＡＷ共振子は圧電基板１１を有し、その圧電基板１１上には、電気信号が入力される入力端子１２が形成されている。入力端子１２には、すだれ状の電極指１４ａが接続されている。圧電基板１１上の入力端子１２の反対側には、入力端子１２と同様に出力端子１３が形成されている。出力端子１３には、すだれ状の電極指１４ｂが電極指１４ａに相対して接続されている。電極指１４ａと電極指１４ｂとでトランスジューサ１４を構成している。トランスジューサ１４は、入力端子１２から入力される電気信号をＳＡＷ１６に変換した後にそのＳＡＷ１６を電気信号に変換するものである。トランスジューサ１４の両側のＳＡＷ１６の伝搬方向Ａ，Ａ´には、反射器１５Ｒ，１５Ｌが設けられている。反射器１５Ｒ，１５Ｌは、端部が連結された複数の電極を有し、これらの電極が平行に等間隔で形成され、ＳＡＷ１６を反射して反射波を発生するものである。次に、図６の動作を説明する。入力端子１２に高周波信号（数百ＫＨｚ以上）が入力されると、入力端子１２に接続された電極指１４ａに高周波電圧がかかり、出力端子１３に接続された電極指１４ｂに誘導的に高周波電圧が発生するが、位相が遅れているので両端子間に電位差が生じる。これによって、電極指１４ａ，１４ｂの下の圧電基板１１の表面が歪み、入力信号と同じ周波数のＳＡＷ１６が励振する。このＳＡＷ１６がトランスジューサ１４の両側のＳＡＷ１６の伝搬方向Ａ，Ａ´に伝搬し、反射器１５Ｒ，１５Ｌで反射されて反射波が発生する。これらの反射波と新たに発生したＳＡＷとが共振して定在波が発生する。この定在波と同一の周波数の電気信号が出力端子１３から出力される。尚、出力端子１３が解放される場合、負荷で終端される場合、及びアースされる場合において、入力端子１２からみた系全体のインピーダンスが異なるが、いずれの場合でもＳＡＷが励振し、共振子の振る舞いをする。図７は、ＳＡＷ共振子の電気的等価回路の回路図である。水晶振動子と同様に、コイルＬ、コンデンサＣ、及び抵抗Ｒの直列回路とＩＤＴの静電容量C0との並列回路で表される。

【０００４】図８は、図７に示すＳＡＷ共振子のリアクタンス特性の特性図である。ＳＡＷ共振子は図８に示すように、共振周波数ｆｒと反共振周波数ｆａとを有する二重共振特性を有している。そのため、ＳＡＷ共振子を従来のＬＣフィルタと同様に構成することにより、帯域通過フィルタを構成することができる。図９は、２つのＳＡＷ共振子を１段梯子型回路に接続した帯域通過フィルタの回路図である。この帯域通過フィルタは、直列腕

ＳＡＷ共振子２１、並列腕ＳＡＷ共振子２２、入力端子２３、及び出力端子２４で構成されている。図１０は、図９の特性を示す図であり、特に同図（ａ）は図９中の直列腕ＳＡＷ共振子２１及び並列腕ＳＡＷ共振子２２のリアクタンス特性を示す図であり、同図（ｂ）は図９の伝送特性Ｓ２１を示す図である。図１０中の各符号の意味は、次の通りである。

ｆ０；梯子型回路の中心周波数
ｆ１；並列腕ＳＡＷ共振子２２の共振周波数
ｆ２；並列腕ＳＡＷ共振子２２の反共振周波数
ｆ３；直列腕ＳＡＷ共振子２１の共振周波数
ｆ４；直列腕ＳＡＷ共振子２１の反共振周波数
Ｐ；通過帯域
Ｄ；減衰域

並列腕ＳＡＷ共振子２２の反共振周波数ｆ２と直列腕ＳＡＷ共振子２１の共振周波数ｆ３とを一致させると、図１０中に示すような伝送特性の帯域通過フィルタを構成できる。一般に、１段梯子型回路では減衰量が大きく取れないので、梯子型回路を縦続接続し、例えば３段や５段等の多段梯子型回路にして使用される。図１１は３段梯子型回路の回路図であり、図１２は５段梯子型回路の回路図である。

【０００５】図１３は、ＳＡＷ共振子を１段梯子型回路に構成した共振器型ＳＡＷフィルタの平面図である。この共振器型ＳＡＷフィルタでは、圧電基板３１上に、直列腕ＳＡＷ共振子のＩＤＴ３２、直列腕ＳＡＷ共振子のグレーティング反射器３３、並列腕ＳＡＷ共振子のＩＤＴ３４、並列腕ＳＡＷ共振子のグレーティング反射器３５、入力用引き出し電極３６、出力用引き出し電極３７、及びアース用引き出し電極３８が設けられている。図１４は、図１３のＡ－Ａ線断面図である。尚、ＩＤＴ３２，３４及びグレーティング反射器３３，３５には、アルミニウムに銅やシリコンを数％含んだアルミニウム合金が用いられ、引き出し電極３６，３７，３８には、金が用いられる。

【０００６】

【発明が解決しようとする課題】しかしながら、直列腕ＳＡＷ共振子と並列腕ＳＡＷ共振子とを１枚の圧電基板上に一体化して形成する際、電極の膜厚及び電極指の幅のばらつき等により、直列腕ＳＡＷ共振子の共振周波数と並列腕ＳＡＷ共振子の反共振周波数とが正確に一致しない場合や或いは一致しても中心周波数がずれる場合がある。そのため、所望の中心周波数や通過帯域幅が得られなくなり、しかも挿入損失の増加や通過帯域におけるリップルの発生等の問題が生ずる。本発明は以上のような問題点を除去し、特性の調整を簡単に行えるＳＡＷ共振子を提供することを目的とする。

【０００７】

【課題を解決するための手段】本発明は、前記課題を解決するために、圧電基板上に設けられ、電気信号をＳＡＷに変換した後にそのＳＡＷを電気信号に変換するＳＡＷ共振子を複数個用いた直列腕ＳＡＷ共振子及び並列腕ＳＡＷ共振子からなる梯子型回路に構成された共振器型ＳＡＷフィルタにおいて、次のような方法で周波数を調整している。即ち、直列腕ＳＡＷ共振子の共振周波数又は反共振周波数を測定し、その測定結果と共振器型ＳＡＷフィルタの中心周波数との比較により直列腕ＳＡＷ共振子上に絶縁膜を被着するか又はエッチング処理を施して直列腕ＳＡＷ共振子の共振周波数又は反共振周波数を調整する。更に、並列腕ＳＡＷ共振子の反共振周波数又は共振周波数を測定し、その測定結果と共振器型ＳＡＷフィルタの中心周波数との比較により並列腕ＳＡＷ共振子上に絶縁膜を被着するか又はエッチング処理を施して並列腕ＳＡＷ共振子の反共振周波数又は共振周波数を調整する。

【０００８】

【作用】本発明によれば、以上のようにＳＡＷ共振器の周波数調整方法を構成したので、直列腕ＳＡＷ共振子上に絶縁膜を被着することにより該絶縁膜下の圧電基板にかかる負荷が大きくなり、直列腕ＳＡＷ共振子の共振周波数又は反共振周波数が低周波側へ移動する。又、直列腕ＳＡＷ共振子をエッチング処理することにより該エッチングされた部分の圧電基板にかかる負荷が小さくなり、直列腕ＳＡＷ共振子の共振周波数又は反共振周波数が高周波側へ移動する。一方、並列腕ＳＡＷ共振子上に絶縁膜を被着することにより並列腕ＳＡＷ共振子の反共振周波数又は共振周波数が低周波側へ移動する。又、並列腕ＳＡＷ共振子をエッチング処理することにより並列腕ＳＡＷ共振子の反共振周波数又は共振周波数が高周波側へ移動する。従って、前記課題を解決できるのである。

【０００９】

【実施例】図１５は、ｆ０＜ｆ２＝ｆ３の場合のリアクタンスの特性図である。図１６は、ｆ２＝ｆ３＜ｆ０の場合のリアクタンスの特性図である。図１７は、ｆ０＜ｆ２＜ｆ３の場合のリアクタンスの特性図である。図１８は、ｆ０＝ｆ２＜ｆ３の場合のリアクタンスの特性図である。図１９は、ｆ２＜ｆ０＜ｆ３の場合のリアクタンスの特性図である。図２０は、ｆ２＜ｆ３＝ｆ０の場合のリアクタンスの特性図である。図２１は、ｆ２＜ｆ３＜ｆ０の場合のリアクタンスの特性図である。図２２は、ｆ２＞ｆ３＞ｆ０の場合のリアクタンスの特性図である。図２３は、ｆ２＞ｆ３＝ｆ０の場合のリアクタンスの特性図である。図２４は、ｆ２＞ｆ０＞ｆ３の場合のリアクタンスの特性図である。図２５は、ｆ２＝ｆ０＞ｆ３の場合のリアクタンスの特性図である。図２６は、ｆ０＞ｆ２＞ｆ３の場合のリアクタンスの特性図である。但し、ｆ０は中心周波数、ｆ２は並列腕ＳＡＷ共振子の反共振周波数、ｆ３は直列腕ＳＡＷ共振子の共振周波数である。以上のように、梯子型回路に構成された

共振器型ＳＡＷフィルタにおいて周波数を調整する必要がある特性は、１２種類存在する。

第１の実施例

第１の実施例では、図１５に示すｆ０＜ｆ２＝ｆ３の場合及び図１６に示すｆ２＝ｆ３＜ｆ０の場合の周波数調整方法を以下（１）及び（２）で説明する。

【００１０】（１）　ｆ０＜ｆ２＝ｆ３の場合

図１は、本発明の第１の実施例の共振器型ＳＡＷフィルタの周波数調整方法１を説明するための共振器型ＳＡＷフィルタの平面図であり、従来の図１３中の要素と共通の要素には共通の符号が付されている。この図１では、図１３中のＩＤＴ３２、グレーティング反射器３３、ＩＤＴ３４、及びグレーティング反射器３５上のそれぞれ全面と、入力用引き出し電極３６、出力用引き出し電極３７、及びアース用引き出し電極３８上のそれぞれ一部に絶縁膜３９ｉが形成されている。図２７は、図１のＡ－Ａ線断面図である。次に、図１の動作を説明する。図１５に示すｆ０＜ｆ２＝ｆ３の場合、ＩＤＴ３２、グレーティング反射器３３、ＩＤＴ３４、及びグレーティング反射器３５全体を覆うように絶縁膜３９ｉを被着すると、圧電基板３１にかかる負荷が大きくなり、直列腕ＳＡＷ共振子及び並列腕ＳＡＷ共振子で発生したＳＡＷの伝搬速度は共に同じ速度だけ低下し、直列腕ＳＡＷ共振子及び並列腕ＳＡＷ共振子のリアクタンス特性は共に低周波側へ移動する。この周波数の移動量は絶縁膜３９ｉの膜厚により調整できるので、ｆ２＝ｆ３＝ｆ０になるまで絶縁膜３９ｉを被着させる。以上の手順でｆ０＜ｆ２＝ｆ３の場合の周波数調整を行うことができる。

【００１１】（２）　ｆ２＝ｆ３＜ｆ０の場合

図２８は、本発明の第１の実施例の周波数調整方法２を説明するための共振器型ＳＡＷフィルタの平面図であり、図１中の要素と共通の要素には共通の符号が付されている。この図２８では、図１中の絶縁膜３９Ａが形成されている領域にエッチング３９Ｅが施されている。図２９は、図２８のＡ－Ａ線断面図である。次に、図２８の動作を説明する。図１６に示すｆ２＝ｆ３＜ｆ０の場合、ＩＤＴ３２、グレーティング反射器３３、ＩＤＴ３４、及びグレーティング反射器３５全体にエッチング３９Ｅを施すと、圧電基板３１にかかる負荷が小さくなり、直列腕ＳＡＷ共振子及び並列腕ＳＡＷ共振子で発生したＳＡＷの伝搬速度は共に同じ速度だけ上昇し、直列腕ＳＡＷ共振子及び並列腕ＳＡＷ共振子のリアクタンス特性は共に高周波側へ移動する。この周波数の移動量はエッチング３９Ｅのエッチング量により調整できるので、ｆ２＝ｆ３＝ｆ０になるまでエッチング領域をエッチングする。以上の手順でｆ２＝ｆ３＜ｆ０の場合の周波数調整を行うことができる。以上のように、この第１の実施例では、ＩＤＴ３２、グレーティング反射器３３、ＩＤＴ３４、及びグレーティング反射器３５全体に絶縁膜３９ｉを被着するか或いはエッチング３９Ｅを施すことにより直列腕ＳＡＷ共振子及び並列腕ＳＡＷ共振子のリアクタンス特性の調整を行い、直列腕ＳＡＷ共振子の共振周波数と並列腕ＳＡＷ共振子の反共振周波数とを所定の中心周波数に一致させることができる。この周波数調整方法により所望の周波数とフィルタ特性を得ることができ、歩留りも向上する。

第２の実施例

第２の実施例では、図１７～図２１に示すｆ２＜ｆ３の場合の共振器型ＳＡＷフィルタの周波数調整方法を説明する。

【００１２】図３０は、本発明の第２の実施例の周波数調整方法１を説明するための共振器型ＳＡＷフィルタの平面図であり、図１３中の要素と共通の要素には共通の符号が付されている。この図３０では、図１３中の直列腕ＳＡＷ共振子を構成するＩＤＴ３２及びグレーティング反射器３３上に絶縁膜３９ｓｉが形成されている。図３１は、図１のＡ－Ａ線断面図である。次に、図３０の動作を説明する。ＩＤＴ３２及びグレーティング反射器３３を覆うように絶縁膜３９ｓｉを被着すると、直列腕ＳＡＷ共振子で発生したＳＡＷの伝搬速度が低下し、直列腕ＳＡＷ共振子のリアクタンス特性は低周波側へ移動する。この周波数の移動量は絶縁膜３９ｓｉの膜厚により調整できるので、ｆ２＜ｆ３の場合、ｆ２＝ｆ３になるまで絶縁膜３９ｓｉを被着させる。図３２は、本発明の第２の実施例の周波数調整方法２を説明するための共振器型ＳＡＷフィルタの平面図であり、図１３中の要素と共通の要素には共通の符号が付されている。この図３２では、図１３中の並列腕ＳＡＷ共振子を構成するＩＤＴ３４及びグレーティング反射器３５の領域にエッチング３９ｐｅが施されている。図３３は、図３２のＡ－Ａ線断面図である。次に、図３２の動作を説明する。ＩＤＴ３４及びグレーティング反射器３５をエッチングすると、並列腕ＳＡＷ共振子で発生したＳＡＷの伝搬速度が上昇し、並列腕ＳＡＷ共振子のリアクタンス特性は高周波側へ移動する。この移動量はエッチング３９ｐｅのエッチング量により調整できるので、ｆ２＜ｆ３の場合、ｆ２＝ｆ３になるまでエッチング領域をエッチングする。

【００１３】以上で、ｆ２＜ｆ３の場合について直列腕ＳＡＷ共振子の共振周波数ｆ３と並列腕ＳＡＷ共振子の反共振周波数ｆ２とを一致させる調整方法を説明した。ｆ２＜ｆ３の場合には中心周波数ｆ０との相対的な大小関係を考慮すると図１７～図２１の５種類がある。これらの５種類の場合の周波数調整方法は、この第２の実施例で示した調整方法と第１の実施例で示した調整方法とを組み合わせることにより調整できる。以上のように、この第２の実施例では、直列腕ＳＡＷ共振子を構成するＩＤＴ３２及びグレーティング反射器３３に絶縁膜３９ｓｉを被着するか又は並列腕ＳＡＷ共振子を構成するＩＤＴ３４及びグレーティング反射器３５にエッチング３

９ｐｅを施すことにより、直列腕ＳＡＷ共振子の共振周波数ｆ３と並列腕ＳＡＷ共振子の反共振周波数ｆ２とを一致させることができる。又、第１の実施例で示した調整方法とを組み合わせることにより、直列腕ＳＡＷ共振子の共振周波数ｆ３と並列腕ＳＡＷ共振子の反共振周波数ｆ２とを中心周波数ｆ０に一致させることができる。この周波数調整方法により、挿入損失の増加や通過帯域におけるリップルの発生等の問題を解決し、所望の周波数とフィルタ特性を得ることができ、歩留りも向上する。

第３の実施例

第３の実施例では、図２２～図２６に示すｆ２＞ｆ３の場合の共振器型ＳＡＷフィルタの周波数調整方法を説明する。図３４は、本発明の第３の実施例の周波数調整方法１を説明するための共振器型ＳＡＷフィルタの平面図であ り、図１３中の要素と共通の要素には共通の符号が付されている。この図３４では、図１３中の並列腕ＳＡＷ共振子を構成するＩＤＴ３４及びグレーティング反射器３５上に絶縁膜３９ｐｉが形成されている。図３５は、図３４のＡ－Ａ線断面図であ る。

【００１４】次に、図３４の動作を説明する。ｆ２＞ｆ３の場合、ＩＤＴ３４及びグレーティング反射器３５を覆うように絶縁膜３９ｐｉを被着すると、並列腕ＳＡＷ共振子で発生したＳＡＷの伝搬速度が低下し、並列腕ＳＡＷ共振子のリアクタンス特性は低周波側へ移動する。この移動量は絶縁膜３９ｐｉの膜厚により調整できるので、ｆ２＝ｆ３になるまで絶縁膜３９ｐｉを被着させる。図３６は、本発明の第３の実施例の共振器型ＳＡＷフィルタの周波数調整方法２を説明するための共振器型ＳＡＷフィルタの平面図であ り、図１３中の要素と共通の要素には共通の符号が付されている。この図３６では、図１３中の直列腕ＳＡＷ共振子を構成するＩＤＴ３２及びグレーティング反射器３３の領域にエッチング３９ｓｅが施されている。図３７は、図３６のＡ－Ａ線断面図であ る。次に、図３６の動作を説明する。ｆ２＞ｆ３の場合、ＩＤＴ３２及びグレーティング反射器３３をエッチングすると、圧電基板３１にかかる負荷が小さくなり、直列腕ＳＡＷ共振子で発生したＳＡＷの伝搬速度が上昇し、直列腕ＳＡＷ共振子のリアクタンス特性は高周波側へ移動する。この移動量はエッチング３９ｓｅのエッチング量により調整できるので、ｆ２＝ｆ３になるまでエッチング領域をエッチングする。以上の手順でｆ２＞ｆ３の場合の周波数調整を行うことができる。以上で、ｆ２＞ｆ３の場合について並列腕ＳＡＷ共振子の反共振周波数ｆ２と直列腕ＳＡＷ共振子の共振周波数ｆ３とを一致させる調整方法を説明した。ｆ２＞ｆ３の場合には中心周波数ｆ０との相対的な大小関係を考慮すると図２２～図２６の５種類があ る。これらの５種類の場合の周波数調整方法は、この第３の実施例で示した調整方法と第１の実施例で示した調整方法とを組み合わせることにより調整できる。

【００１５】以上のように、この第３の実施例では、並列腕ＳＡＷ共振子を構成するＩＤＴ３４及びグレーティング反射器３５に絶縁膜３９ｐｉを被着するか又は直列腕ＳＡＷ共振子を構成するＩＤＴ３２及びグレーティング反射器３３にエッチング３９ｓｅを施すことにより、並列腕ＳＡＷ共振子の反共振周波数ｆ２と直列腕ＳＡＷ共振子の共振周波数ｆ３とを一致させることができる。又、第１の実施例で示した調整方法とを組み合わせることにより、直列腕ＳＡＷ共振子の共振周波数ｆ３と並列腕ＳＡＷ共振子の反共振周波数ｆ２とを中心周波数ｆ０に一致させることができる。この周波数調整方法により、挿入損失の増加や通過帯域におけるリップルの発生等の問題を解決し、所望の周波数とフィルタ特性を得ることができ、歩留りも向上する。尚、本発明は上記実施例に限定されず、種々の変形が可能であ る。その変形例としては、例えば、次のようなものがあ る。

（１）　実施例では１段梯子型の共振器型ＳＡＷフィルタを用いて説明したが、多段型の共振器型ＳＡＷフィルタにおいても適用でき、同様の効果が得られる。

（２）　本発明の周波数調整方法は、ＳＡＷ共振子のリアクタンス特性を調整する場合にも適用できる。

（３）　ＳＡＷ共振子の上に絶縁膜を形成する領域及びエッチングを施す領域を種々の範囲の領域にすることによって、ＳＡＷ共振子のリアクタンス特性を調整することもできる。

【００１６】

【発明の効果】以上詳細に説明したように、本発明によれば、直列腕ＳＡＷ共振子上に絶縁膜を被着するか又はエッチング処理を施して直列腕ＳＡＷ共振子の共振周波数又は反共振周波数を調整し、更に、並列腕ＳＡＷ共振子上に絶縁膜を被着するか又はエッチング処理を施して並列腕ＳＡＷ共振子の反共振周波数又は共振周波数を調整するようにしたので、直列腕ＳＡＷ共振子の共振周波数又は反共振周波数と並列腕ＳＡＷ共振子の反共振周波数又は共振周波数とを一致させることができ、更に、中心周波数と一致させることができる。従って、所望の中心周波数及び通過帯域幅が得られ、通過帯域中のリップル発生の防止や挿入損失を低下できる。

【図面の簡単な説明】

【図１】本発明の第１の実施例の周波数調整方法１を実施するための共振器型ＳＡＷフィルタの平面図であ る。

【図２】トランスバーサル型ＳＡＷフィルタの平面図であ る。

【図３】ＳＡＷ共振子の概念図であ る。

【図４】梯子型回路の構成図であ る。

【図５】２重モード型ＳＡＷ共振子の構成図であ る。

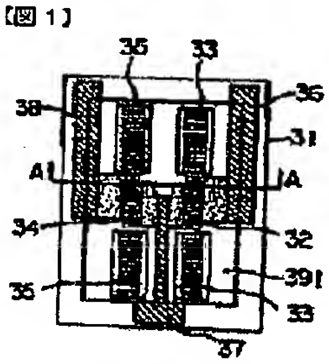
【図６】反射器型ＳＡＷ共振子の平面図であ る。

【図７】ＳＡＷ共振子の等価回路の回路図であ る。

【図８】ＳＡＷ共振子のリアクタンスの特性図であ る。

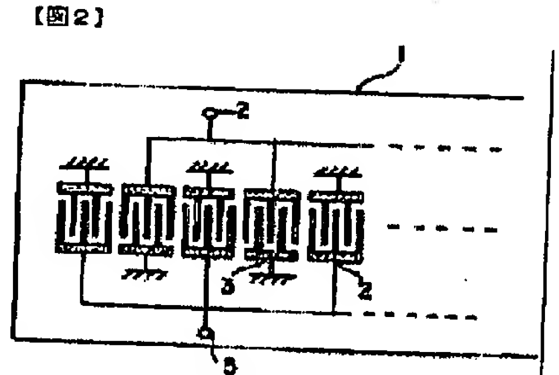
【図9】1段梯子型回路の回路図である。
【図10】図9の特性図である。
【図11】3段梯子型回路の回路図である。
【図12】5段梯子型回路の回路図である。
【図13】共振器型SAWフィルタの平面図である。
【図14】図13のA−A線断面図である。
【図15】f0<f2=f3の場合のリアクタンスの特性図である。
【図16】f2=f3<f0の場合のリアクタンスの特性図である。
【図17】f0<f2<f3の場合のリアクタンスの特性図である。
【図18】f0=f2<f3の場合のリアクタンスの特性図である。
【図19】f2<f0<f3の場合のリアクタンスの特性図である。
【図20】f2<f3=f0の場合のリアクタンスの特性図である。
【図21】f2<f3<f0の場合のリアクタンスの特性図である。
【図22】f2>f3>f0の場合のリアクタンスの特性図である。
【図23】f2>f3=f0の場合のリアクタンスの特性図である。
【図24】f2>f0>f3の場合のリアクタンスの特性図である。
【図25】f2=f0>f3の場合のリアクタンスの特性図である。
【図26】f0>f2>f3の場合のリアクタンスの特性図である。
【図27】図1のA−A線断面図である。
【図28】本発明の第1の実施例の周波数調整方法2を実施するための共振器型SAWフィルタの平面図である。
【図29】図28のA−A線断面図である。
【図30】本発明の第2の実施例の周波数調整方法1を実施するための共振器型SAWフィルタの平面図である。
【図31】図30のA−A線断面図である。
【図32】本発明の第2の実施例の周波数調整方法2を実施するための共振器型SAWフィルタの平面図である。
【図33】図32のA−A線断面図である。
【図34】本発明の第3の実施例の周波数調整方法1を実施するための共振器型SAWフィルタの平面図である。
【図35】図34のA−A線断面図である。
【図36】本発明の第3の実施例の周波数調整方法2を実施するための共振器型SAWフィルタの平面図である。
【図37】図36のA−A線断面図である。
【符号の説明】
21 直列腕SAW共振子
22 並列腕SAW共振子
31 圧電基板
39I, 39I, 39pI 絶縁膜
39E, 39pe, 39se, エッチング
f0 中心周波数
f2 反共振周波数
f3 共振周波数

【図1】



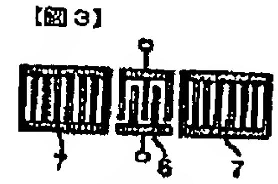
本発明の第1の実施例の周波数調整方法1

【図2】



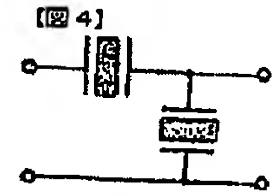
トランスバーサル型SAWフィルタ

【図3】



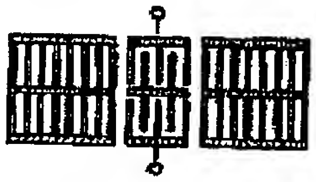
SAW共振子

【図4】



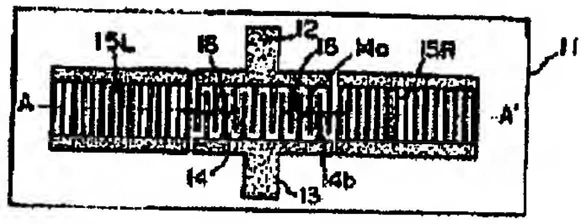
梯子型回路

【図5】



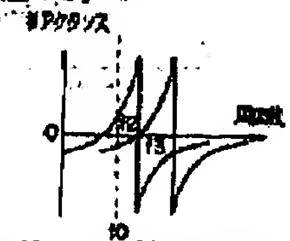
2端子…ド型SAW共振子

【図6】



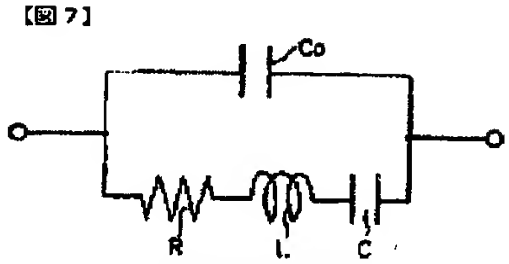
反射器型SAW共振子

【図15】



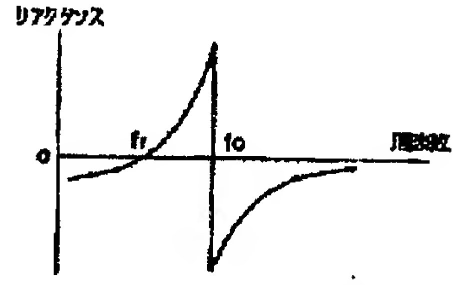
f0<f2＝f3の場合のリアクタンス特性

【図7】



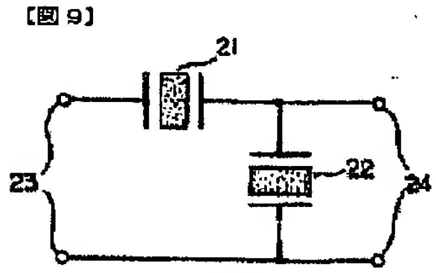
SAW共振子の等価回路

【図8】



SAW共振子のリアクタンス特性

【図9】



1段梯子型回路

【図10】

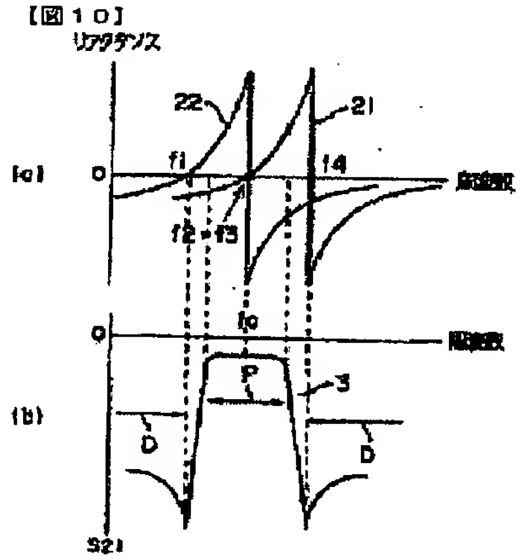
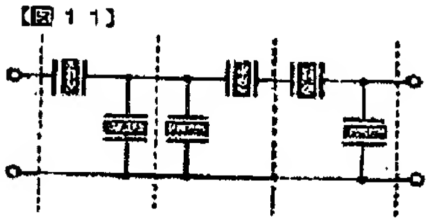


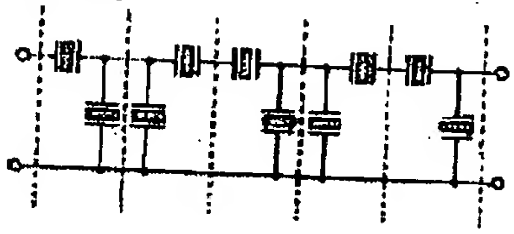
図9の特性図

【図11】



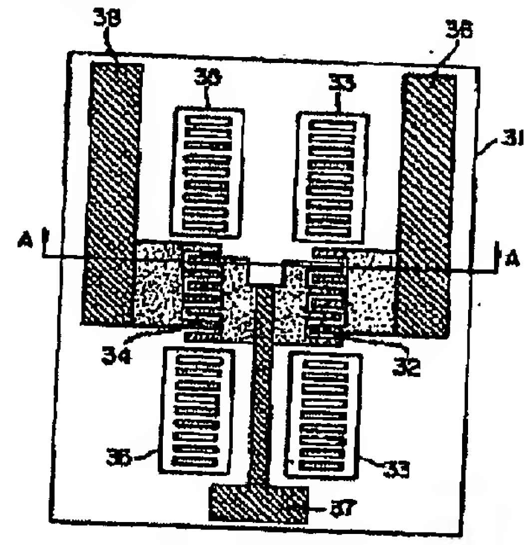
3段梯子型回路

【図12】



5段梯子型回路

【図13】



共振器型SAWフィルタ

【図14】

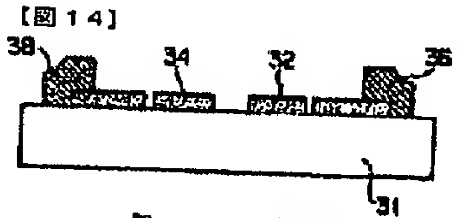
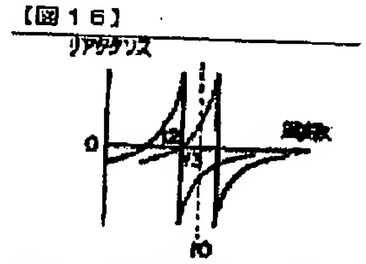


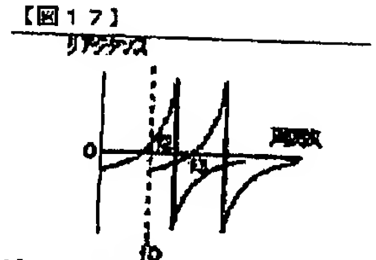
図13のA－A線断面図

【図16】



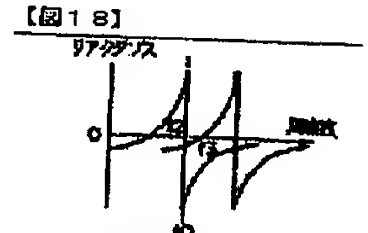
f2＝f3＜f0の場合のリアクタンス特性

【図17】



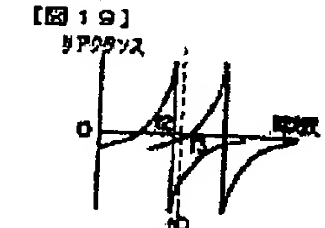
f0＜f2＜f3 の場合のリアクタンス特性

【図18】



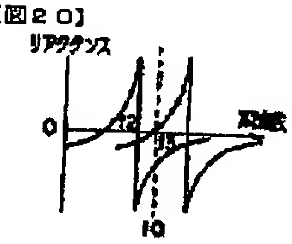
f0＝f2＜f3の場合のリアクタンス特性

【図19】



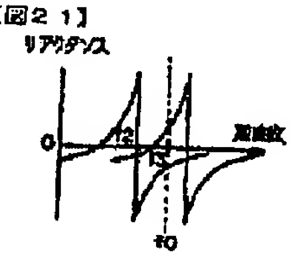
f2＜f0＜f3 の場合のリアクタンス特性

【図20】



f2＜f3＝f0の場合のリアクタンス特性

【図21】



f2＜f3＜f0 の場合のリアクタンス特性

【図29】

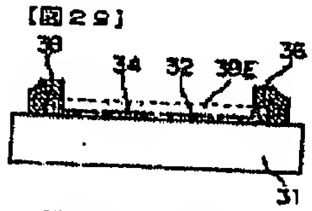


図28のA－A線断面図

【図31】

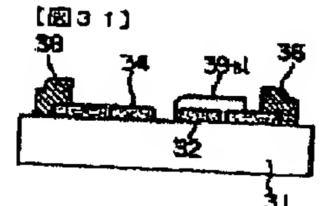
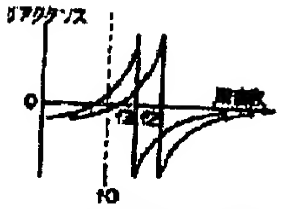


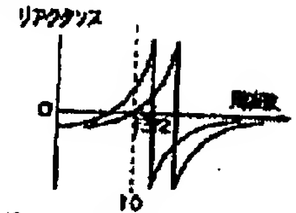
図30のA－A線断面図

【図２２】



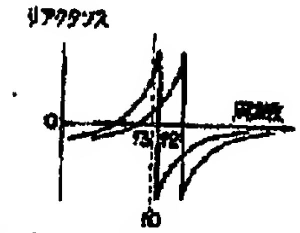
f2>f3>f0の場合のリアクタンス特性

【図２３】



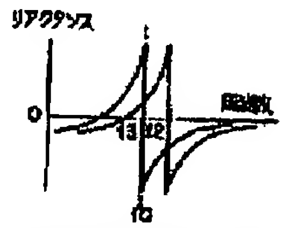
f2>f3＝f0の場合のリアクタンス特性

【図２４】



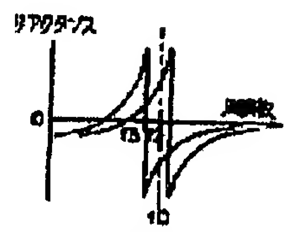
f2>f0>f3の場合のリアクタンス特性

【図２５】



f2＝f0>f3の場合のリアクタンス特性

【図２６】



f0>f2>f3の場合のリアクタンス特性

【図２７】

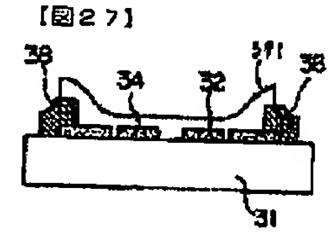
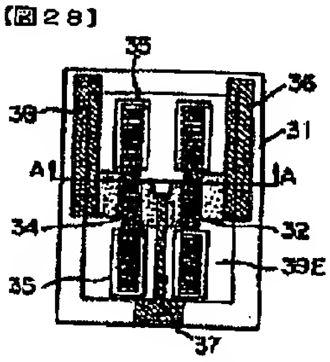


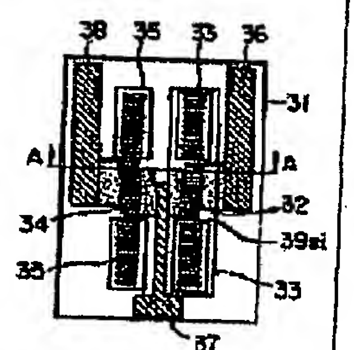
図１のA－A線断面図

【図２８】



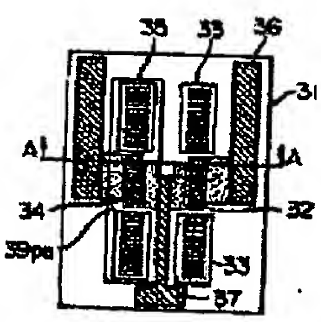
本発明の第１の実施例の周波数調整方法２

【図３０】



本発明の第２の実施例の周波数調整方法１

【図３２】



本発明の第２の実施例の周波数調整方法２

【図３３】

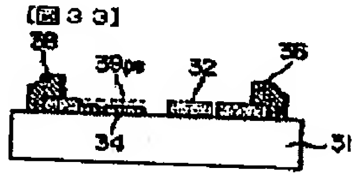


図３２のA－A線断面図

【図３５】

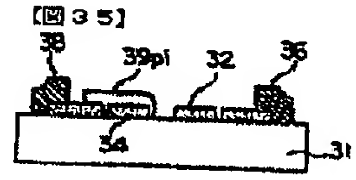


図３４のA－A線断面図

【図３７】

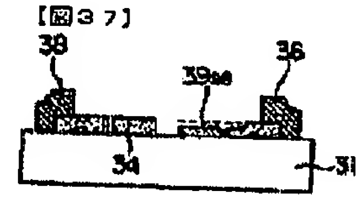
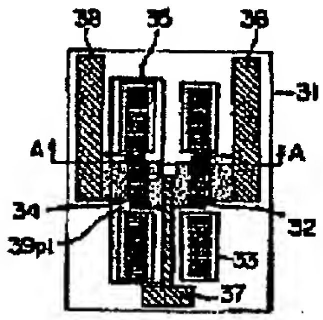


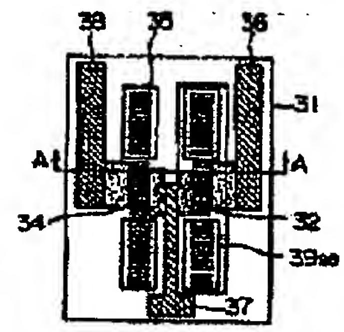
図３６のA－A線断面図

【図34】



本発明の第3の実施例の周波数調整方法1

【図35】



本発明の第3の実施例の周波数調整方法2

フロントページの続き

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the frequency regulation approach in the resonator mold surface acoustic wave (it is called SAW Surface Acoustic Wave and the following) filter used for the RF signal-processing sections, such as a cell phone unit, etc.
[0002]
[Description of the Prior Art] Surface acoustic wave equipment is equipment which changes an electrical signal into a surface acoustic wave by the blind-like electrode or converter (it is called IDT Interdigital Transducer and the following) arranged on a piezo-electric substrate. A surface acoustic wave filter has the features of small, a light weight, and no adjusting, especially, and since the photolithography technique used for the manufacture process at manufacture of a semiconductor device can be used, it excels also in mass-production nature. Generally an SAW filter is classified into a transversal mold and a resonator mold. Drawing 2 is structural drawing showing the configuration of the conventional general transversal mold SAW filter. Two or more IDT(s)3 for an input connected to the input terminal 2 and two or more IDT(s)4 for an output connected to the output terminal 5 are formed on the piezo-electric substrate 1 at this transversal mold SAW filter. The transversal mold SAW filter has structure which has arranged much IDT(s)3 for an input, and IDT(s)4 for an output by turns. Drawing 3 is the conceptual diagram of a SAW resonator. This SAW resonator is equipped with IDT6 and the grating reflector 7. A resonator mold SAW filter is constituted using the SAW resonator which consisted of IDT and a grating reflector. A resonator mold SAW filter is classified into a ladder mold and a double mode type. Drawing 4 is the block diagram of a ladder mold circuit using two SAW resonators shown in drawing 3 , and drawing 5 is the block diagram of a double mode type SAW resonator. Generally, a resonator mold SAW filter has the description of low loss, the high magnitude of attenuation, a narrow-band, and matching circuit needlessness compared with a transversal mold SAW filter.
[0003] Drawing 6 is the top view of a reflector mold SAW resonator. This SAW resonator has the piezo-electric substrate 11, and the input terminal 12 into which an electrical signal is inputted is formed on that piezo-electric substrate 11. Blind-like electrode finger 14a is connected to the input terminal 12. The output terminal 13 is formed in the opposite side of the input terminal 12 on the piezo-electric substrate 11 like the input terminal 12. Blind-like electrode finger 14b faces electrode finger 14a, and is connected to the output terminal 13. The transducer 14 consists of electrode finger 14a and electrode finger 14b. A transducer 14 changes the SAW16 into an electrical signal, after changing into SAW16 the electrical signal inputted from an input terminal 12. Reflectors 15R and 15L are formed in the propagation direction A of SAW16 of the both sides of a transducer 14, and A'. Reflectors 15R and 15L have two or more electrodes with which the edge was connected, and these electrodes are formed at equal intervals in parallel, reflect SAW16, and they generate a reflected wave. Next, actuation of drawing 6 is explained. If a RF signal (hundreds of kHz or more) is inputted into an input terminal 12, high-frequency voltage will occur inductively in electrode finger 14b which high-frequency voltage was built over electrode finger 14a connected to the input terminal 12, and was connected to the output terminal 13, but since the phase is behind, the potential difference arises among both-ends children. By this, SAW16 of the frequency as distortion and an input signal with the same front face of the piezo-electric substrate 11 under the electrode fingers 14a and 14b excites. This SAW16 spreads to the propagation direction A of SAW16 of the both sides of a transducer 14, and A', it is reflected with Reflectors 15R and 15L, and a reflected wave occurs. These reflected waves and newly generated SAW resonate, and a standing wave occurs. The electrical

signal of the same frequency as this standing wave is outputted from an output terminal 13. In addition, although the impedances of the whole system seen from the input terminal 12 differ when [by which termination is carried out by the load] an output terminal 13 is released, and case and grounded, in any case, SAW excites and a resonator is served. Drawing 7 is the circuit diagram of the electrical equivalent circuit of a SAW resonator. They are Coil L, Capacitor C, and the series circuit of Resistance R and the electrostatic capacity C0 of IDT like a quartz resonator. It is expressed in a parallel circuit.

[0004] Drawing 8 is a property Fig. of the reactive characteristic of a SAW resonator shown in drawing 7 . The SAW resonator has the duplex resonance characteristic which has resonance frequency fr and antiresonant frequency fa, as shown in drawing 8 . Therefore, a band-pass filter can be constituted by constituting a SAW resonator like the conventional LC filter. Drawing 9 is the circuit diagram of the band-pass filter which connected two SAW resonators to the one-step ladder mold circuit. This band-pass filter consists of the serial arm SAW resonator 21, a juxtaposition arm SAW resonator 22, an input terminal 23, and an output terminal 24. Drawing 10 is drawing showing the property of drawing 9 , especially this drawing (a) is drawing showing the reactive characteristic of the serial arm SAW resonator 21 in drawing 9 , and the juxtaposition arm SAW resonator 22, and this drawing (b) is drawing showing the transmission characteristic S21 of drawing 9 . The semantics of each sign in drawing 10 is as follows.

f0; Center frequency f1; of a ladder mold circuit Resonance frequency f2; of the juxtaposition arm SAW resonator 22 The antiresonant frequency P; passband D of the resonance frequency f4; serial arm SAW resonator 21 of the antiresonant frequency f3; serial arm SAW resonator 21 of the juxtaposition arm SAW resonator 22; if the antiresonant frequency f2 of the decay area juxtaposition arm SAW resonator 22 and the resonance frequency f3 of the serial arm SAW resonator 21 are made in agreement The band-pass filter of a transmission characteristic as shown in drawing 10 can be constituted. Generally, since the large magnitude of attenuation cannot be taken in an one-step ladder mold circuit, cascade connection of the ladder mold circuit is carried out, for example, it is used by making it multistage ladder mold circuits, such as three steps and five etc. steps. Drawing 11 is the circuit diagram of a three-step ladder mold circuit, and drawing 12 is the circuit diagram of a five-step ladder mold circuit.

[0005] Drawing 13 is the top view of the resonator mold SAW filter which constituted the SAW resonator in the one-step ladder mold circuit. In this resonator mold SAW filter, IDT34 of IDT32 of a serial arm SAW resonator, the grating reflector 33 of a serial arm SAW resonator, and a juxtaposition arm SAW resonator, the grating reflector 35 of a juxtaposition arm SAW resonator, the drawer electrode 36 for an input, the drawer electrode 37 for an output, and the drawer electrode 38 for a ground are formed on the piezo-electric substrate 31. Drawing 14 is the A-A line sectional view of drawing 13 . In addition, the aluminium alloy which contained copper and silicon in aluminum several% is used for IDT 32 and 34 and the grating reflectors 33 and 35, and gold is used for the drawer electrodes 36, 37, and 38.

[0006]

[Problem(s) to be Solved by the Invention] However, in case a serial arm SAW resonator and a juxtaposition arm SAW resonator are unified and formed on one piezo-electric substrate, even if in agreement [with dispersion in the thickness of an electrode, and the width of face of an electrode finger etc.] when the resonance frequency of a serial arm SAW resonator and the antiresonant frequency of a juxtaposition arm SAW resonator are not correctly in agreement or, center frequency may shift. Therefore, desired center frequency and pass band width are no longer obtained, and, moreover, problems, such as an increment in an insertion loss and generating of the ripple in a passband, arise. This invention removes the above troubles and aims at offering the SAW resonator which can adjust a property easily.

[0007]

[Means for Solving the Problem] In order to solve said technical problem, this invention is prepared on a piezo-electric substrate, and after it changes an electrical signal into SAW, it is adjusting the frequency by the following approaches in the resonator mold SAW filter constituted by the ladder mold circuit which consists of a serial arm SAW resonator and a juxtaposition arm SAW resonator using the SAW resonator which changes the SAW into an electrical signal two or more. That is, the resonance frequency or antiresonant frequency of a serial arm SAW resonator is measured, and an insulator layer is put on a serial arm SAW resonator by the comparison with the measurement result and the center frequency of a resonator mold SAW filter, or etching processing is performed, and the resonance frequency or antiresonant frequency of a serial arm SAW resonator is adjusted. Furthermore, the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator is measured, and an insulator layer is put on a juxtaposition arm SAW resonator by the comparison with the measurement result and the center frequency of a resonator mold SAW filter, or etching processing is performed, and the antiresonant frequency or resonance frequency of a juxtaposition arm

SAW resonator is adjusted.
[0008]
[Function] According to this invention, since the frequency regulation approach of a SAW resonator was constituted as mentioned above, by putting an insulator layer on a serial arm SAW resonator, the load concerning the piezo-electric substrate under this insulator layer becomes large, and the resonance frequency or antiresonant frequency of a serial arm SAW resonator moves to a low frequency side. Moreover, by carrying out etching processing of the serial arm SAW resonator, the load concerning the piezo-electric substrate of the this etched part becomes small, and the resonance frequency or antiresonant frequency of a serial arm SAW resonator moves to a RF side. On the other hand, the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator moves to a low frequency side by putting an insulator layer on a juxtaposition arm SAW resonator. Moreover, the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator moves to a RF side by carrying out etching processing of the juxtaposition arm SAW resonator. Therefore, said technical problem is solvable.
[0009]
[Example] Drawing 15 is the property Fig. of the reactance in f0<f2=f3. Drawing 16 is the property Fig. of the reactance in f2=f3<f0. Drawing 17 is the property Fig. of the reactance in f0<f2<f3. Drawing 18 is the property Fig. of the reactance in f0=f2<f3. Drawing 19 is the property Fig. of the reactance in f2<f0<f3. Drawing 20 is the property Fig. of the reactance in f2<f3=f0. Drawing 21 is the property Fig. of the reactance in f2<f3<f0. Drawing 22 is the property Fig. of the reactance in f2>f3>f0. Drawing 23 is the property Fig. of the reactance in f2>f3=f0. Drawing 24 is the property Fig. of the reactance in f2>f0>f3. Drawing 25 is the property Fig. of the reactance in f2=f0>f3. Drawing 26 is the property Fig. of the reactance in f0>f2>f3. However, as for center frequency and f2, f0 is [the antiresonant frequency of a juxtaposition arm SAW resonator and f3] the resonance frequency of a serial arm SAW resonator. As mentioned above, 12 kinds of properties that it is necessary to adjust a frequency in the resonator mold SAW filter constituted by the ladder mold circuit exist.
In the 1st example [1st] of an example, (1) and (2) explain below the frequency regulation approach in f2=f3<f0 shown in the case of f0<f2=f3 and drawing 16 which are shown in drawing 15 .
[0010] (1) In the case of f0<f2=f3, drawing 1 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 1 of the resonator mold SAW filter of the 1st example of this invention, and the common sign is given to the element in conventional drawing 13 , and the common element. this drawing 1 -- each on IDT32, the grating reflector 33, IDT34, and the grating reflector 35 in drawing 13 -- each on the whole surface, the drawer electrode 36 for an input and the drawer electrode 37 for an output, and the drawer electrode 38 for a ground -- insulator layer 39I is formed in the part. Drawing 27 is the A-A line sectional view of drawing 1 . Next, actuation of drawing 1 is explained. If in the case of f0<f2=f3 shown in drawing 15 insulator layer 39I is put so that IDT32, the grating reflector 33, IDT34, and the grating reflector 35 whole may be covered, the load concerning the piezo-electric substrate 31 becomes large, only the rate with both the same velocity of propagation of SAW generated in the serial arm SAW resonator and the juxtaposition arm SAW resonator will fall, and both the reactive characteristics of a serial arm SAW resonator and a juxtaposition arm SAW resonator will move it to a low frequency side. Insulator layer 39I is made to put, since the thickness of insulator layer 39I can adjust the movement magnitude of this frequency until it is set to f2=f3=f0. The above procedure can perform frequency regulation in f0<f2=f3.
[0011] (2) In the case of f2=f3<f0, drawing 28 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 2 of the 1st example of this invention, and the common sign is given to the element in drawing 1 , and the common element. Etching 39E is given to the field in which insulator layer 39A in drawing 1 is formed in this drawing 28 . Drawing 29 is the A-A line sectional view of drawing 28 . Next, actuation of drawing 28 is explained. If etching 39E is given to IDT32, the grating reflector 33, IDT34, and the grating reflector 35 whole in the case of f2=f3<f0 shown in drawing 16 , the load concerning the piezo-electric substrate 31 becomes small, only the rate with both the same velocity of propagation of SAW generated in the serial arm SAW resonator and the juxtaposition arm SAW resonator will rise, and both the reactive characteristics of a serial arm SAW resonator and a juxtaposition arm SAW resonator will move it to a RF side. Since the amount of etching of etching 39E can adjust the movement magnitude of this frequency, an etching field is etched until it is set to f2=f3=f0. The above procedure can perform frequency regulation in f2=f3<f0. As mentioned above, by putting insulator layer 39I on IDT32, the grating reflector 33, IDT34, and the grating reflector 35 whole, or giving etching 39E, the reactive characteristic of a serial arm SAW resonator and a juxtaposition arm SAW resonator can be adjusted, and the resonance frequency of a serial arm SAW

resonator and the antiresonant frequency of a juxtaposition arm SAW resonator can be made in agreement with predetermined center frequency in this 1st example. A desired frequency and a desired filter shape can be obtained by this frequency regulation approach, and the yield also improves.

The 2nd example [2nd] of an example explains the frequency regulation approach of the resonator mold SAW filter in f2<f3 shown in drawing 17 - drawing 21 .

[0012] Drawing 30 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 1 of the 2nd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. In this drawing 30 , insulator layer 39si is formed on IDT32 which constitutes the serial arm SAW resonator in drawing 13 , and the grating reflector 33. Drawing 31 is the A-A line sectional view of drawing 1 . Next, actuation of drawing 30 is explained. If insulator layer 39si is put so that IDT32 and the grating reflector 33 may be covered, the velocity of propagation of SAW generated in the serial arm SAW resonator will fall, and the reactive characteristic of a serial arm SAW resonator will move to a low frequency side. Insulator layer 39si is made to put in the case of f2<f3, since the thickness of insulator layer 39si can adjust the movement magnitude of this frequency until it is set to f2=f3. Drawing 32 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 2 of the 2nd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. Etching 39pe is given to the field of IDT34 which constitutes the juxtaposition arm SAW resonator in drawing 13 , and the grating reflector 35 in this drawing 32 . Drawing 33 is the A-A line sectional view of drawing 32 . Next, actuation of drawing 32 is explained. If IDT34 and the grating reflector 35 are etched, the velocity of propagation of SAW generated in the juxtaposition arm SAW resonator will rise, and the reactive characteristic of a juxtaposition arm SAW resonator will move to a RF side. Since the amount of etching of etching 39pe can adjust this movement magnitude, in the case of f2<f3, an etching field is etched until it is set to f2=f3.

[0013] Above, the adjustment approach which makes the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator in agreement about the case of f2<f3 was explained. When relative size relation with center frequency f0 is taken into consideration in the case of f2<f3, there are five kinds of drawing 17 - drawing 21 . The frequency regulation approach in these five kinds can be adjusted by combining the adjustment approach shown in the adjustment approach shown in this 2nd example, and the 1st example. As mentioned above, the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator can be made in agreement by giving etching 39pe to IDT34 and the grating reflector 35 which put insulator layer 39si on IDT32 and the grating reflector 33 which constitute a serial arm SAW resonator, or constitute a juxtaposition arm SAW resonator from this 2nd example. Moreover, the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator can be made in agreement with center frequency f0 by combining the adjustment approach shown in the 1st example. By this frequency regulation approach, problems, such as an increment in an insertion loss and generating of the ripple in a passband, can be solved, a desired frequency and a desired filter shape can be obtained, and the yield also improves.

The 3rd example [3rd] of an example explains the frequency regulation approach of the resonator mold SAW filter in f2>f3 shown in drawing 22 - drawing 26 . Drawing 34 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 1 of the 3rd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. In this drawing 34 , insulator layer 39pi is formed on IDT34 which constitutes the juxtaposition arm SAW resonator in drawing 13 , and the grating reflector 35. Drawing 35 is the A-A line sectional view of drawing 34 .

[0014] Next, actuation of drawing 34 is explained. f2> If in the case of f3 insulator layer 39pi is put so that IDT34 and the grating reflector 35 may be covered, the velocity of propagation of SAW generated in the juxtaposition arm SAW resonator will fall, and the reactive characteristic of a juxtaposition arm SAW resonator will move to a low frequency side. Insulator layer 39pi is made to put, since the thickness of insulator layer 39pi can adjust this movement magnitude until it is set to f2=f3. Drawing 36 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 2 of the resonator mold SAW filter of the 3rd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. Etching 39se is given to the field of IDT32 which constitutes the serial arm SAW resonator in drawing 13 , and the grating reflector 33 in this drawing 36 . Drawing 37 is the A-A line sectional view of drawing 36 . Next, actuation of drawing 36 is explained. f2> If IDT32 and the grating reflector 33 are etched in the case of f3, the load concerning the piezo-electric substrate 31 will become small, the velocity of propagation of SAW generated in the serial arm SAW resonator will rise, and the reactive characteristic of a

serial arm SAW resonator will move to a RF side. Since the amount of etching of etching 39se can adjust this movement magnitude, an etching field is etched until it is set to f2=f3. The above procedure can perform frequency regulation in f2>f3. Above, the adjustment approach which makes the antiresonant frequency f2 of a juxtaposition arm SAW resonator and the resonance frequency f3 of a serial arm SAW resonator in agreement about the case of f2>f3 was explained. f2> When relative size relation with center frequency f0 is taken into consideration in the case of f3, there are five kinds of drawing 22 - drawing 26 . The frequency regulation approach in these five kinds can be adjusted by combining the adjustment approach shown in the adjustment approach shown in this 3rd example, and the 1st example.

[0015] As mentioned above, the antiresonant frequency f2 of a juxtaposition arm SAW resonator and the resonance frequency f3 of a serial arm SAW resonator can be made in agreement by giving etching 39se to IDT32 and the grating reflector 33 which put insulator layer 39pi on IDT34 and the grating reflector 35 which constitute a juxtaposition arm SAW resonator, or constitute a serial arm SAW resonator from this 3rd example. Moreover, the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator can be made in agreement with center frequency f0 by combining the adjustment approach shown in the 1st example. By this frequency regulation approach, problems, such as an increment in an insertion loss and generating of the ripple in a passband, can be solved, a desired frequency and a desired filter shape can be obtained, and the yield also improves. In addition, this invention is not limited to the above-mentioned example, but various deformation is possible for it. As the ******, there is the following, for example.

(1) Although the example explained using the resonator mold SAW filter of an one-step ladder mold, it can apply also in the resonator mold SAW filter of a multistage type, and the same effectiveness is acquired.

(2) The frequency regulation approach of this invention can be applied also when adjusting the reactive characteristic of a SAW resonator.

(3) The reactive characteristic of a SAW resonator can also be adjusted by making into the field of various profiles the field which performs the field and etching which form an insulator layer on a SAW resonator.

[0016]

[Effect of the Invention] As explained to the detail above, according to this invention, put an insulator layer on a serial arm SAW resonator, or perform etching processing, and the resonance frequency or antiresonant frequency of a serial arm SAW resonator is adjusted. Furthermore, since an insulator layer is put on a juxtaposition arm SAW resonator, or etching processing is performed and the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator was adjusted The resonance frequency of a serial arm SAW resonator or antiresonant frequency, the antiresonant frequency of a juxtaposition arm SAW resonator, or resonance frequency can be made in agreement, and it can be made further in agreement with center frequency. Therefore, desired center frequency and pass band width are obtained, and prevention of ripple generating in a passband and an insertion loss can be fallen.

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TECHNICAL FIELD

[Industrial Application] This invention relates to the frequency regulation approach in the resonator mold surface acoustic wave (it is called SAW Surface Acoustic Wave and the following) filter used for the RF signal-processing sections, such as a cell phone unit, etc.

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PRIOR ART

[Description of the Prior Art] Surface acoustic wave equipment is equipment which changes an electrical signal into a surface acoustic wave by the blind-like electrode or converter (it is called IDT Interdigital Transducer and the following) arranged on a piezo-electric substrate. A surface acoustic wave filter has the features of small, a light weight, and no adjusting, especially, and since the photolithography technique used for the manufacture process at manufacture of a semiconductor device can be used, it excels also in mass-production nature. Generally an SAW filter is classified into a transversal mold and a resonator mold. Drawing 2 is structural drawing showing the configuration of the conventional general transversal mold SAW filter. Two or more IDT(s)3 for an input connected to the input terminal 2 and two or more IDT(s)4 for an output connected to the output terminal 5 are formed on the piezo-electric substrate 1 at this transversal mold SAW filter. The transversal mold SAW filter has structure which has arranged much IDT(s)3 for an input, and IDT(s)4 for an output by turns. Drawing 3 is the conceptual diagram of a SAW resonator. This SAW resonator is equipped with IDT6 and the grating reflector 7. A resonator mold SAW filter is constituted using the SAW resonator which consisted of IDT and a grating reflector. A resonator mold SAW filter is classified into a ladder mold and a double mode type. Drawing 4 is the block diagram of a ladder mold circuit using two SAW resonators shown in drawing 3 , and drawing 5 is the block diagram of a double mode type SAW resonator. Generally, a resonator mold SAW filter has the description of low loss, the high magnitude of attenuation, a narrow-band, and matching circuit needlessness compared with a transversal mold SAW filter.
[0003] Drawing 6 is the top view of a reflector mold SAW resonator. This SAW resonator has the piezo-electric substrate 11, and the input terminal 12 into which an electrical signal is inputted is formed on that piezo-electric substrate 11. Blind-like electrode finger 14a is connected to the input terminal 12. The output terminal 13 is formed in the opposite side of the input terminal 12 on the piezo-electric substrate 11 like the input terminal 12. Blind-like electrode finger 14b faces electrode finger 14a, and is connected to the output terminal 13. The transducer 14 consists of electrode finger 14a and electrode finger 14b. A transducer 14 changes the SAW16 into an electrical signal, after changing into SAW16 the electrical signal inputted from an input terminal 12. Reflectors 15R and 15L are formed in the propagation direction A of SAW16 of the both sides of a transducer 14, and A'. Reflectors 15R and 15L have two or more electrodes with which the edge was connected, and these electrodes are formed at equal intervals in parallel, reflect SAW16, and they generate a reflected wave. Next, actuation of drawing 6 is explained. If a RF signal (hundreds of kHz or more) is inputted into an input terminal 12, high-frequency voltage will occur inductively in electrode finger 14b which high-frequency voltage was built over electrode finger 14a connected to the input terminal 12, and was connected to the output terminal 13, but since the phase is behind, the potential difference arises among both-ends children. By this, SAW16 of the frequency as distortion and an input signal with the same front face of the piezo-electric substrate 11 under the electrode fingers 14a and 14b excites. This SAW16 spreads to the propagation direction A of SAW16 of the both sides of a transducer 14, and A', it is reflected with Reflectors 15R and 15L, and a reflected wave occurs. These reflected waves and newly generated SAW resonate, and a standing wave occurs. The electrical signal of the same frequency as this standing wave is outputted from an output terminal 13. In addition, although the impedances of the whole system seen from the input terminal 12 differ when [by which termination is carried out by the load] an output terminal 13 is released, and case and grounded, in any case, SAW excites and a resonator is served. Drawing 7 is the circuit diagram of the electrical equivalent circuit of a SAW resonator. They are Coil L, Capacitor C, and the series circuit of Resistance R and the electrostatic capacity C0 of IDT like a quartz resonator. It is expressed in a parallel circuit.

[0004] Drawing 8 is a property Fig. of the reactive characteristic of a SAW resonator shown in drawing 7 . The SAW resonator has the duplex resonance characteristic which has resonance frequency fr and antiresonant frequency fa, as shown in drawing 8 . Therefore, a band-pass filter can be constituted by constituting a SAW resonator like the conventional LC filter. Drawing 9 is the circuit diagram of the band-pass filter which connected two SAW resonators to the one-step ladder mold circuit. This band-pass filter consists of the serial arm SAW resonator 21, a juxtaposition arm SAW resonator 22, an input terminal 23, and an output terminal 24. Drawing 10 is drawing showing the property of drawing 9 , especially this drawing (a) is drawing showing the reactive characteristic of the serial arm SAW resonator 21 in drawing 9 , and the juxtaposition arm SAW resonator 22, and this drawing (b) is drawing showing the transmission characteristic S21 of drawing 9 . The semantics of each sign in drawing 10 is as follows.
f0; Center frequency f1; of a ladder mold circuit Resonance frequency f2; of the juxtaposition arm SAW resonator 22 The antiresonant frequency P; passband D of the resonance frequency f4; serial arm SAW resonator 21 of the antiresonant frequency f3; serial arm SAW resonator 21 of the juxtaposition arm SAW resonator 22; if the antiresonant frequency f2 of the decay area juxtaposition arm SAW resonator 22 and the resonance frequency f3 of the serial arm SAW resonator 21 are made in agreement The band-pass filter of a transmission characteristic as shown in drawing 10 can be constituted. Generally, since the large magnitude of attenuation cannot be taken in an one-step ladder mold circuit, cascade connection of the ladder mold circuit is carried out, for example, it is used by making it multistage ladder mold circuits, such as three steps and five etc. steps. Drawing 11 is the circuit diagram of a three-step ladder mold circuit, and drawing 12 is the circuit diagram of a five-step ladder mold circuit.
[0005] Drawing 13 is the top view of the resonator mold SAW filter which constituted the SAW resonator in the one-step ladder mold circuit. In this resonator mold SAW filter, IDT34 of IDT32 of a serial arm SAW resonator, the grating reflector 33 of a serial arm SAW resonator, and a juxtaposition arm SAW resonator, the grating reflector 35 of a juxtaposition arm SAW resonator, the drawer electrode 36 for an input, the drawer electrode 37 for an output, and the drawer electrode 38 for a ground are formed on the piezo-electric substrate 31. Drawing 14 is the A-A line sectional view of drawing 13 . In addition, the aluminium alloy which contained copper and silicon in aluminum several% is used for IDT 32 and 34 and the grating reflectors 33 and 35, and gold is used for the drawer electrodes 36, 37, and 38.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained to the detail above, in this invention, an insulator layer is put on a serial arm SAW resonator, or etching processing is performed, the resonance frequency or antiresonant frequency of a serial arm SAW resonator is adjusted, an insulator layer is further put on a juxtaposition arm SAW resonator, or etching processing is performed, and the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator was adjusted. Therefore, the resonance frequency of a serial arm SAW resonator or antiresonant frequency, the antiresonant frequency of a juxtaposition arm SAW resonator, or resonance frequency can be made in agreement, and it can be made further in agreement with center frequency. Therefore, desired center frequency and pass band width are obtained, and prevention of ripple generating in a passband and an insertion loss can be fallen.

[Translation done.]

* NOTICES *

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in case a serial arm SAW resonator and a juxtaposition arm SAW resonator are unified and formed on one piezo-electric substrate, even if in agreement [with dispersion in the thickness of an electrode, and the width of face of an electrode finger etc.] when the resonance frequency of a serial arm SAW resonator and the antiresonant frequency of a juxtaposition arm SAW resonator are not correctly in agreement or, center frequency may shift. Therefore, desired center frequency and pass band width are no longer obtained, and, moreover, problems, such as an increment in an insertion loss and generating of the ripple in a passband, arise. This invention removes the above troubles and aims at offering the SAW resonator which can adjust a property easily.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve said technical problem, this invention is prepared on a piezo-electric substrate, and after it changes an electrical signal into SAW, it is adjusting the frequency by the following approaches in the resonator mold SAW filter constituted by the ladder mold circuit which consists of a serial arm SAW resonator and a juxtaposition arm SAW resonator using the SAW resonator which changes the SAW into an electrical signal two or more. That is, the resonance frequency or antiresonant frequency of a serial arm SAW resonator is measured, and an insulator layer is put on a serial arm SAW resonator by the comparison with the measurement result and the center frequency of a resonator mold SAW filter, or etching processing is performed, and the resonance frequency or antiresonant frequency of a serial arm SAW resonator is adjusted. Furthermore, the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator is measured, and an insulator layer is put on a juxtaposition arm SAW resonator by the comparison with the measurement result and the center frequency of a resonator mold SAW filter, or etching processing is performed, and the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator is adjusted.

[Translation done.]

* NOTICES *

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OPERATION

[Function] According to this invention, since the frequency regulation approach of a SAW resonator was constituted as mentioned above, by putting an insulator layer on a serial arm SAW resonator, the load concerning the piezo-electric substrate under this insulator layer becomes large, and the resonance frequency or antiresonant frequency of a serial arm SAW resonator moves to a low frequency side. Moreover, by carrying out etching processing of the serial arm SAW resonator, the load concerning the piezo-electric substrate of the this etched part becomes small, and the resonance frequency or antiresonant frequency of a serial arm SAW resonator moves to a RF side. On the other hand, the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator moves to a low frequency side by putting an insulator layer on a juxtaposition arm SAW resonator. Moreover, the antiresonant frequency or resonance frequency of a juxtaposition arm SAW resonator moves to a RF side by carrying out etching processing of the juxtaposition arm SAW resonator. Therefore, said technical problem is solvable.

[Translation done.]

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EXAMPLE

[Example] Drawing 15 is the property Fig. of the reactance in f0<f2=f3. Drawing 16 is the property Fig. of the reactance in f2=f3<f0. Drawing 17 is the property Fig. of the reactance in f0<f2<f3. Drawing 18 is the property Fig. of the reactance in f0=f2<f3. Drawing 19 is the property Fig. of the reactance in f2<f0<f3. Drawing 20 is the property Fig. of the reactance in f2<f3=f0. Drawing 21 is the property Fig. of the reactance in f2<f3<f0. Drawing 22 is the property Fig. of the reactance in f2>f3>f0. Drawing 23 is the property Fig. of the reactance in f2>f3=f0. Drawing 24 is the property Fig. of the reactance in f2>f0>f3. Drawing 25 is the property Fig. of the reactance in f2=f0>f3. Drawing 26 is the property Fig. of the reactance in f0>f2>f3. However, as for center frequency and f2, f0 is [the antiresonant frequency of a juxtaposition arm SAW resonator and f3] the resonance frequency of a serial arm SAW resonator. As mentioned above, 12 kinds of properties that it is necessary to adjust a frequency in the resonator mold SAW filter constituted by the ladder mold circuit exist.
In the 1st example [1st] of an example, (1) and (2) explain below the frequency regulation approach in f2=f3<f0 shown in the case of f0<f2=f3 and drawing 16 which are shown in drawing 15 .
[0010] (1) In the case of f0<f2=f3, drawing 1 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 1 of the resonator mold SAW filter of the 1st example of this invention, and the common sign is given to the element in conventional drawing 13 , and the common element. this drawing 1 -- each on IDT32, the grating reflector 33, IDT34, and the grating reflector 35 in drawing 13 -- each on the whole surface, the drawer electrode 36 for an input and the drawer electrode 37 for an output, and the drawer electrode 38 for a ground -- insulator layer 39I is formed in the part. Drawing 27 is the A-A line sectional view of drawing 1 . Next, actuation of drawing 1 is explained. If in the case of f0<f2=f3 shown in drawing 15 insulator layer 39I is put so that IDT32, the grating reflector 33, IDT34, and the grating reflector 35 whole may be covered, the load concerning the piezo-electric substrate 31 becomes large, only the rate with both the same velocity of propagation of SAW generated in the serial arm SAW resonator and the juxtaposition arm SAW resonator will fall, and both the reactive characteristics of a serial arm SAW resonator and a juxtaposition arm SAW resonator will move it to a low frequency side. Insulator layer 39I is made to put, since the thickness of insulator layer 39I can adjust the movement magnitude of this frequency until it is set to f2=f3=f0. The above procedure can perform frequency regulation in f0<f2=f3.
[0011] (2) In the case of f2=f3<f0, drawing 28 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 2 of the 1st example of this invention, and the common sign is given to the element in drawing 1 , and the common element. Etching 39E is given to the field in which insulator layer 39A in drawing 1 is formed in this drawing 28 . Drawing 29 is the A-A line sectional view of drawing 28 . Next, actuation of drawing 28 is explained. If etching 39E is given to IDT32, the grating reflector 33, IDT34, and the grating reflector 35 whole in the case of f2=f3<f0 shown in drawing 16 , the load concerning the piezo-electric substrate 31 becomes small, only the rate with both the same velocity of propagation of SAW generated in the serial arm SAW resonator and the juxtaposition arm SAW resonator will rise, and both the reactive characteristics of a serial arm SAW resonator and a juxtaposition arm SAW resonator will move it to a RF side. Since the amount of etching of etching 39E can adjust the movement magnitude of this frequency, an etching field is etched until it is set to f2=f3=f0. The above procedure can perform frequency regulation in f2=f3<f0. As mentioned above, by putting insulator layer 39I on IDT32, the grating reflector 33, IDT34, and the grating reflector 35 whole, or giving etching 39E, the reactive characteristic of a serial arm SAW resonator and a juxtaposition arm SAW resonator can be adjusted, and the resonance frequency of a serial arm SAW resonator and the antiresonant frequency of a juxtaposition arm SAW resonator can be made in agreement with

predetermined center frequency in this 1st example. A desired frequency and a desired filter shape can be obtained by this frequency regulation approach, and the yield also improves.
The 2nd example [2nd] of an example explains the frequency regulation approach of the resonator mold SAW filter in f2<f3 shown in drawing 17 - drawing 21 .
[0012] Drawing 30 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 1 of the 2nd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. In this drawing 30 , insulator layer 39si is formed on IDT32 which constitutes the serial arm SAW resonator in drawing 13 , and the grating reflector 33. Drawing 31 is the A-A line sectional view of drawing 1 . Next, actuation of drawing 30 is explained. If insulator layer 39si is put so that IDT32 and the grating reflector 33 may be covered, the velocity of propagation of SAW generated in the serial arm SAW resonator will fall, and the reactive characteristic of a serial arm SAW resonator will move to a low frequency side. Insulator layer 39si is made to put in the case of f2<f3, since the thickness of insulator layer 39si can adjust the movement magnitude of this frequency until it is set to f2=f3. Drawing 32 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 2 of the 2nd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. Etching 39pe is given to the field of IDT34 which constitutes the juxtaposition arm SAW resonator in drawing 13 , and the grating reflector 35 in this drawing 32 . Drawing 33 is the A-A line sectional view of drawing 32 . Next, actuation of drawing 32 is explained. If IDT34 and the grating reflector 35 are etched, the velocity of propagation of SAW generated in the juxtaposition arm SAW resonator will rise, and the reactive characteristic of a juxtaposition arm SAW resonator will move to a RF side. Since the amount of etching of etching 39pe can adjust this movement magnitude, in the case of f2<f3, an etching field is etched until it is set to f2=f3.
[0013] Above, the adjustment approach which makes the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator in agreement about the case of f2<f3 was explained. When relative size relation with center frequency f0 is taken into consideration in the case of f2<f3, there are five kinds of drawing 17 - drawing 21 . The frequency regulation approach in these five kinds can be adjusted by combining the adjustment approach shown in the adjustment approach shown in this 2nd example, and the 1st example. As mentioned above, the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator can be made in agreement by giving etching 39pe to IDT34 and the grating reflector 35 which put insulator layer 39si on IDT32 and the grating reflector 33 which constitute a serial arm SAW resonator, or constitute a juxtaposition arm SAW resonator from this 2nd example. Moreover, the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator can be made in agreement with center frequency f0 by combining the adjustment approach shown in the 1st example. By this frequency regulation approach, problems, such as an increment in an insertion loss and generating of the ripple in a passband, can be solved, a desired frequency and a desired filter shape can be obtained, and the yield also improves.
The 3rd example [3rd] of an example explains the frequency regulation approach of the resonator mold SAW filter in f2>f3 shown in drawing 22 - drawing 26 . Drawing 34 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 1 of the 3rd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. In this drawing 34 , insulator layer 39pi is formed on IDT34 which constitutes the juxtaposition arm SAW resonator in drawing 13 , and the grating reflector 35. Drawing 35 is the A-A line sectional view of drawing 34 .
[0014] Next, actuation of drawing 34 is explained. f2> If in the case of f3 insulator layer 39pi is put so that IDT34 and the grating reflector 35 may be covered, the velocity of propagation of SAW generated in the juxtaposition arm SAW resonator will fall, and the reactive characteristic of a juxtaposition arm SAW resonator will move to a low frequency side. Insulator layer 39pi is made to put, since the thickness of insulator layer 39pi can adjust this movement magnitude until it is set to f2=f3. Drawing 36 is the top view of the resonator mold SAW filter for explaining the frequency regulation approach 2 of the resonator mold SAW filter of the 3rd example of this invention, and the common sign is given to the element in drawing 13 , and the common element. Etching 39se is given to the field of IDT32 which constitutes the serial arm SAW resonator in drawing 13 , and the grating reflector 33 in this drawing 36 . Drawing 37 is the A-A line sectional view of drawing 36 . Next, actuation of drawing 36 is explained. f2> If IDT32 and the grating reflector 33 are etched in the case of f3, the load concerning the piezo-electric substrate 31 will become small, the velocity of propagation of SAW generated in the serial arm SAW resonator will rise, and the reactive characteristic of a serial arm SAW resonator will move to a RF side. Since the amount of etching of etching 39se can adjust this

movement magnitude, an etching field is etched until it is set to f2=f3. The above procedure can perform frequency regulation in f2>f3. Above, the adjustment approach which makes the antiresonant frequency f2 of a juxtaposition arm SAW resonator and the resonance frequency f3 of a serial arm SAW resonator in agreement about the case of f2>f3 was explained. f2> When relative size relation with center frequency f0 is taken into consideration in the case of f3, there are five kinds of drawing 22 - drawing 26 . The frequency regulation approach in these five kinds can be adjusted by combining the adjustment approach shown in the adjustment approach shown in this 3rd example, and the 1st example.

[0015] As mentioned above, the antiresonant frequency f2 of a juxtaposition arm SAW resonator and the resonance frequency f3 of a serial arm SAW resonator can be made in agreement by giving etching 39se to IDT32 and the grating reflector 33 which put insulator layer 39pi on IDT34 and the grating reflector 35 which constitute a juxtaposition arm SAW resonator, or constitute a serial arm SAW resonator from this 3rd example. Moreover, the resonance frequency f3 of a serial arm SAW resonator and the antiresonant frequency f2 of a juxtaposition arm SAW resonator can be made in agreement with center frequency f0 by combining the adjustment approach shown in the 1st example. By this frequency regulation approach, problems, such as an increment in an insertion loss and generating of the ripple in a passband, can be solved, a desired frequency and a desired filter shape can be obtained, and the yield also improves. In addition, this invention is not limited to the above-mentioned example, but various deformation is possible for it. As the ******, there is the following, for example.

(1) Although the example explained using the resonator mold SAW filter of an one-step ladder mold, it can apply also in the resonator mold SAW filter of a multistage type, and the same effectiveness is acquired.

(2) The frequency regulation approach of this invention can be applied also when adjusting the reactive characteristic of a SAW resonator.

(3) The reactive characteristic of a SAW resonator can also be adjusted by making into the field of various profiles the field which performs the field and etching which form an insulator layer on a SAW resonator.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the top view of the resonator mold SAW filter for enforcing the frequency regulation approach 1 of the 1st example of this invention.
[Drawing 2] It is the top view of a transversal mold SAW filter.
[Drawing 3] It is the conceptual diagram of a SAW resonator.
[Drawing 4] It is the block diagram of a ladder mold circuit.
[Drawing 5] It is the block diagram of a double mode type SAW resonator.
[Drawing 6] It is the top view of a reflector mold SAW resonator.
[Drawing 7] It is the circuit diagram of the equal circuit of a SAW resonator.
[Drawing 8] It is the property Fig. of the reactance of a SAW resonator.
[Drawing 9] It is the circuit diagram of an one-step ladder mold circuit.
[Drawing 10] It is the property Fig. of drawing 9 .
[Drawing 11] It is the circuit diagram of a three-step ladder mold circuit.
[Drawing 12] It is the circuit diagram of a five-step ladder mold circuit.
[Drawing 13] It is the top view of a resonator mold SAW filter.
[Drawing 14] It is the A-A line sectional view of drawing 13 .
[Drawing 15] It is the property Fig. of the reactance in $f0<f2=f3$.
[Drawing 16] It is the property Fig. of the reactance in $f2=f3<f0$.
[Drawing 17] It is the property Fig. of the reactance in $f0<f2<f3$.
[Drawing 18] It is the property Fig. of the reactance in $f0=f2<f3$.
[Drawing 19] It is the property Fig. of the reactance in $f2<f0<f3$.
[Drawing 20] It is the property Fig. of the reactance in $f2<f3=f0$.
[Drawing 21] It is the property Fig. of the reactance in $f2<f3<f0$.
[Drawing 22] $f2>f3>$ It is the property Fig. of the reactance in f0.
[Drawing 23] It is the property Fig. of the reactance in $f2>f3=f0$.
[Drawing 24] $f2>f0>$ It is the property Fig. of the reactance in f3.
[Drawing 25] $f2=f0>$ It is the property Fig. of the reactance in f3.
[Drawing 26] $f0>f2>$ It is the property Fig. of the reactance in f3.
[Drawing 27] It is the A-A line sectional view of drawing 1 .
[Drawing 28] It is the top view of the resonator mold SAW filter for enforcing the frequency regulation approach 2 of the 1st example of this invention.
[Drawing 29] It is the A-A line sectional view of drawing 28 .
[Drawing 30] It is the top view of the resonator mold SAW filter for enforcing the frequency regulation approach 1 of the 2nd example of this invention.
[Drawing 31] It is the A-A line sectional view of drawing 30 .
[Drawing 32] It is the top view of the resonator mold SAW filter for enforcing the frequency regulation approach 2 of the 2nd example of this invention.
[Drawing 33] It is the A-A line sectional view of drawing 32 .
[Drawing 34] It is the top view of the resonator mold SAW filter for enforcing the frequency regulation approach 1 of

the 3rd example of this invention.
[Drawing 35] It is the A-A line sectional view of drawing 34 .
[Drawing 36] It is the top view of the resonator mold SAW filter for enforcing the frequency regulation approach 2 of the 3rd example of this invention.
[Drawing 37] It is the A-A line sectional view of drawing 36 .
[Description of Notations]
21 [ ] Serial Arm SAW Resonator
22 [ ] Juxtaposition Arm SAW Resonator
31 [ ] Piezo-electric Substrate
39I, 39i, 39pi Insulator layer
39E, 39pe, 39se Etching
f0 Center frequency
f2 Antiresonant frequency
f3 Resonance frequency

[Translation done.]